Array of Optical Signal Processing Devices

Moveable Reflector

'714 Claims 18 and 19: "Array of Optical Signal Processing Devices"

18. A light processing system, comprising:

... an array of optical signal processing devices located on one or more semiconductor substrates

. . . at least some of the optical signal processing devices comprise:

. . . a plurality of at least partially reflective mirrors . . .

'714 Claims 18 and 19: "Array of Optical Signal Processing Devices"

19. A method of processing one or more optical signals, the method comprising:

... receiving at least the first portion of the first signal part at an array of optical signal processing devices, the array of optical signal processing devices located on one or more semiconductor substrates and comprising a plurality of at least partially reflective mirrors . . .

'714 Patent, Claims 18 and 19: "Array of Optical Signal Processing Devices"

Cheetah's Construction

Defendants' Construction

A plurality of mirrors arranged in a regular pattern that process the optical signal

Array of variable blazed gratings

'714 Claims 18 and 19: "Moveable Reflector"

18. A light processing system, comprising:

... a moveable reflector operable to receive at least some of the portion of the first signal part from the array of optical signal processing devices . . .

'714 Claims 18 and 19: "Moveable Reflector"

19. A method of processing one or more optical signals, the method comprising:

... receiving at a moveable reflector at least some of the first portion of the first signal part from the array of optical signal processing devices ...

'714 Claims 18 and 19: "Moveable Reflector"

Cheetah's Construction

Defendants' Construction

A mirror that moves as a result of an applied voltage

A variable blazed grating

The '714 Patent's Title Proves the Purported Invention Requires the Use of Variable Blazed Gratings

The title states the scope of the purported invention

VARIABLE MANUFACTURES BARNESS

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MPEP Section 606.01 ("Where the title is not descriptive of the invention claimed, the examiner should require the substitution of a new title that is clearly indicative of the invention to which the claims are directed.").

'714 Patent, col. 1 II. 31-39.

The '714 Patent's Overview Confirms the Purported Invention Requires the Use of Variable Blazed Gratings

...

THE REAL PROPERTY AND PARTY.

CROSS MOTORINES TO MILE STORY

The explanation is a continuation to good of aggression for the Section 11 and 11 and

DISCRECASE, PRINTS OF THE SAVENTION.

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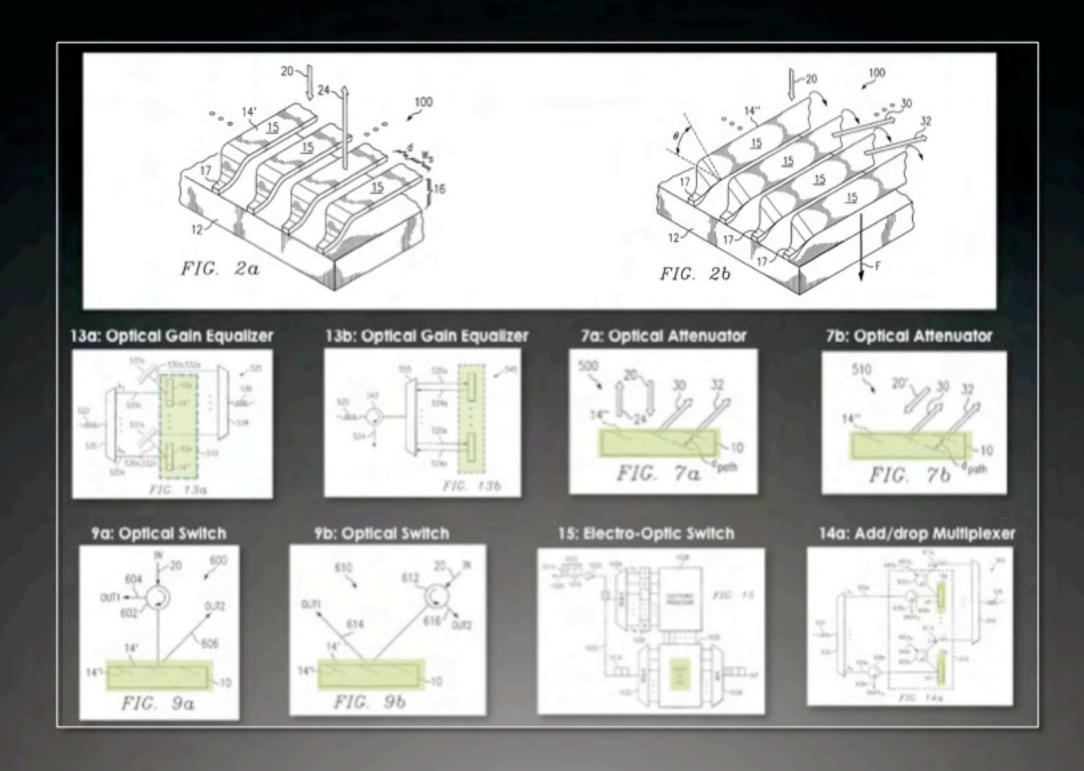
OVERVIEW

processing also escalates. Various devices and methodologies have been developed to provide numerous signal processing capabilities on optical signals. Some of these devices attempt to control a diffraction of an input optical signal to facilitate basic signal processing functions.

One such approach, known as a variable blazed grating, implements a movable diffraction grating that can be selectively displaced to cause a majority of the diffracted input signal to travel in a particular direction. In some aspects of

'714 Patent, col. 1 II. 31-39.

Every Embodiment of the '714 Uses Variable Blazed Gratings



Variable Blazed Gratings are Referred to 145 Times in the '714 Patent

US 7,339,714 B1

ATPMG BASED VARIABLE MLAZED GR SIGNAL PROCESSENG

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of application Set. No. 10/723,107, entitled "Optical Logic Gate Based Optical Rosser," sled on Nov. 25, 2003, now U.S. Par. No. 6,943,925. Application Ser. No. 10723,307 is a continuotion-in-part of application Ser. No. 09/776,052 by Mobusts and N. Islam, filed Feb. 2, 2001, outsided "Variable Observed writing Based Signal Processing," which is now U.S. Pat. n. 6,721,473. Application Ser. No. 09:770,052 is related in

least partially nethering mirrors that are disposed onto from the inner conductive layer. The mirrors are operable to sective at least some of the portion of the first signal part. In one particular cerbodiment, at least some of the micross are s operable to undergo a partial rotation in response to the control signal. The partial rotation resulting in a reflection of the at least some of the portion of the first signal part in one direction. The system also includes an optical reflector that is operable to receive at least some of the modulated first signal port and to communicate the at least sense of the modulated first signal part to an output interface.

Depending on the specific features implemented, participate lar embodiments of the present invention may exhibit some. none, or all of the following technical advantages. One aspect of the present investion provides at efficient and cost

blazed grating

and appointus operable to facilities high speed optical signal. It processing also escalates. Various devices and methodologies have been developed to provide namerous signal pro-cessing capabilities on optical signals. Some of these devices attempt to control a diffraction of an input optical signal to facilitate basic signal processing functions.

One such approach, known as a variable blassed graving. implements a movable diffraction grating that can be selectively displaced to cause a majority of the diffracted input signal to travel in a particular direction. In some aspects of operation, variable blased gratings operate to reflect or 40 diffract signals along the some signal peth as that of an optical signal being upon to the grating. If left unchecked, the input and output signals traveling on the same path can ateries with one mother, or the output signal could cause complications to the source of the input signal.

SUMMARY OF EXAMPLE EMBODMENTS.

In one embodiment, a light processing system comprises an optical tap that is operable to receive an unmodulated to optical signal and to separate the unmodulated optical signal into a first signal part and a second signal past. The system also comprises a light pipe that is operable to commun at least the first signal part for processing. The system father includes on optical signal separator that is operable to 55 switch; receive at least the first signal part and to direct at least a portion of the first signal part for modulation by an array of optical signal processing devices. The array of optical signal processing devices are sociated on one or more semiconductor substrates. The processing devices are openable to exreceive at least some of the portion of the first signal part and to modulate that portion of the first signal pure based at least in part on a control signal received from a controller. At least inner conductive layer that comprises an at least substantially conductive material. Moreover, at least some of the example embodiments of biased graing based wavelength tially conductive material. Moreover, at least some of the optical signal processing devices comprise a plurality of at

conjunction with the accompanying daywings, it who FIGS. Le-Le are block diagrams illustrating greatly

critegel stress action views of various exemplary embod-ments of blazed protag based apparatus operable to facilitate high speed optical signal processing:

FIGS. In and 20-disastrate plante views of one particular embodiment of an apparatus operable to facilities high speed optical rigaal processing:

PIGS. See are cross sectional and planer disquares distriing one example of a blazed grating device;

FIGS. 4ac- are cross-sectional and planne diagrams show-ing another example of a financi graing device. FIGS. 5ac- are cross-sectional and plant of agreems showing still another example of a blazed enting device;

FRES. See-c are cross-sectional and planter disgrams drowing yet another example of a blazed grating device; F165. 7a and 7b illustrate blazed grating based variable

FIG. 8 is a block diagram showing a combination of a variable blased grating and so optical circulator.

FIGS \$2-85 are block diagrams illustrating examples of laced grating based 1×2 optical switcher; 516.95. 58a-58af are block disposes, illustrating various

modes of operation of a blaved grating based 2x2 optical

FIGS. Ha-Hå an block diagrams illustrating examples of various embodiments of blavel grating based optical addidrop multiplexers. TWo \$2 is a block diagram showing one example of a

novel system for facilitating multiple-wavelength signal 130/S. 13a-136 are block (imports illustrating example)

of various embodiments of a blazed grating based optical

...But Cheetah Argues that the Claims Do Not Require Variable Blazed Gratings

as "a plurality of at least partially reflective mirrors." Nothing in the asserted claims requires that the array comprise "variable blazed gratings." Defendants improperly import that detail from a preferred embodiment described in the '714 specification.

Cheetah's Claim Construction Br. at 9.

...But Cheetah Argues that the Claims Do Not Require Variable Blazed Gratings

Cheetah misreads its specification

FIG. 1a shows a cross-section view of one exemplary embodiment of a variable blazed grating-based apparatus 100 operable to facilitate high speed optical signal processing. Throughout this document, the term "signal processing" includes attenuation, switching, phase shifting, or any other manipulation of one or more optical signals.

In this example, apparatus 100 includes a substrate 12 and a plurality of strips 14 disposed outwardly from substrate 12. In a particular embodiment, substrate 12 comprises a semiconductor substrate formed, for example, from silicon. Other materials could be used for substrate 12 without departing from the scope of the invention.

Each strip 14 has a width (W_s) , and is separated from adjacent strips by a distance (d). The width (W_s) and the distance (d) define a periodicity associated with the strips. Multiple strips 14 are operable to receive a single input optical signal 20 having a beam width (W_b) . Strips 14 are sized and spaced from one another in a manner to ensure that the width (W_b) of received optical beam 20 covers at least two strips 14. In this example, strips 14 residing at position 14' are spaced from substrate 12 by a distance 16. Although strips 14 are shown as generally rectangular in shape, any shape can be used consistent with the invention. In addition, although strips 14 are shown as having a constant width (W_s) , that measurement could vary between strips, or even along the same strip 14.



"The '714 specification specifically states that optical devices other than variable blazed gratings may be used"

Cheetah's Reply at 9.

...But Cheetah Argues that the Claims Do Not Require Variable Blazed Gratings

Cheetah misreads its specification

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The paragraph is referring to a variable blazed grating



"The '714 specification specifically states that optical devices other than variable blazed gratings may be used"

Cheetah's Reply at 9.

Cheetah Can Identify No Support for Devices Other than Variable Blazed Gratings

"Support" Identified by Cheetah

These examples show two particular configurations for using a blazed grating as a 2×2 optical switch. It should be noted that any number of 2×2 optical switches can be combined to form an array of n×n switches. Moreover, although particular configuration has been described with respect to FIGS. 10a-10d, numerous modifications could be made without departing from the scope of the invention. For example, switches implementing different geometric configurations, or different numbers of blazed grating elements, circulators, reflective surfaces, or other optical elements are contemplated as being within the scope of the invention.

'714 Patent, col. 14 II. 55-65.

"The '714 specification specifically states that optical devices other than variable blazed gratings may be used"

Cheetah's Reply at 9.

Cheetah Can Identify No Support for Devices Other than Variable Blazed Gratings

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blazed gratings

"The '714 specification specifically states that optical devices other than variable blazed gratings may be used"

Cheetah's Reply at 9.

'714 Patent, col. 14 II. 55-65.

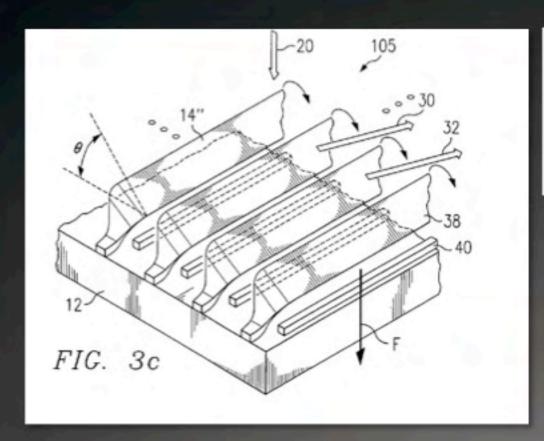
The Boilerplate Identified by Cheetan Does Not Discuss Any Signal Processing Device Other than a Blazed Grating

These examples show two particular configurations for using a blazed grating as a 2×2 optical switch. It should be noted that any number of 2×2 optical switches can be combined to form an array of n×n switches. Moreover, although particular configuration has been described with respect to FIGS. 10a-10d, numerous modifications could be made without departing from the scope of the invention. For example, switches implementing different geometric configurations, or different numbers of blazed grating elements, circulators, reflective surfaces, or other optical elements are contemplated as being within the scope of the invention.

'714 Patent, col. 14 II. 55-65.

- Does not teach the use of any other MEMS device
- Does not state that a system could be built with no blazed grating

The '714 Patent Shows the Use of Variable Blazed Gratings in Which Only Some of the Mirror Strips Rotate



In the illustrated example, a common voltage (or ground) is applied to all strips 14. Alternatively, selected strips 14 could be rotated while others remain stationary.

'714 Patent, col. 7 II. 39-42.

"Moveable Reflector" Is Not Found in the Written Description

The patent discusses "variable blazed gratings" in detail

The term "moveable reflector" does not appear a single time prior to the claims

The Boilerplate Identified by Cheetah Does Not Describe "Moveable Reflector"

These examples show two particular configurations for using a blazed grating as a 2×2 optical switch. It should be noted that any number of 2×2 optical switches can be combined to form an array of n×n switches. Moreover, although particular configuration has been described with respect to FIGS. 10a-10d, numerous modifications could be made without departing from the scope of the invention. For example, switches implementing different geometric configurations, or different numbers of blazed grating elements, circulators, reflective surfaces, or other optical elements are contemplated as being within the scope of the invention.

'714 Patent, col. 14 II. 55-65.

- Does not support a reflective surface that moves (other than a variable blazed grating)
- "Reflective surface" does not suggest a moving reflective surface
- "Optical elements" does not describe a moveable reflector
- Does not support the combination of elements found in claims 18 and 19
- Does not suggest going without a blazed grating

Claims 18 and 19

18. A light processing system, comprising:

an optical divider operable to receive an unmodulated 40 optical signal and to separate the unmodulated optical signal into a first signal part and a second signal part;

a light pipe operable to communicate at least the first signal part for processing;

an optical signal separator operable to receive at least the 45 first signal part and to direct at least a portion of the first signal part for modulation;

an array of optical signal processing devices located on one or more semiconductor substrates, the array of optical signal processing devices operable to receive at 50 least some of the portion of the first signal part and to modulate that portion of the first signal part based at least in part on a control signal received from a controller, at least some of the optical signal processing devices comprise:

an inner conductive layer comprising an at least substantially conductive material; and

- a plurality of at least partially reflective mirrors disposed outwardly from the inner conductive layer and operable to receive at least some of the portion of the first signal part, wherein at least some of the mirrors are operable to undergo a partial rotation in response to the control signal, the partial rotation resulting in a reflection of the at least some of the portion of the first signal part, and wherein a majority of the 65 reflected signal is communicated in one direction; and
- a moveable reflector operable to receive at least some of the portion of the first signal part from the array of optical signal processing devices and to reflect that portion of the first signal part to an optical reflector, the optical reflector operable to receive at least some of the modulated first signal part and to communicate the at least some of the modulated first signal part to an output interface.

Claim 18 and 19 require both

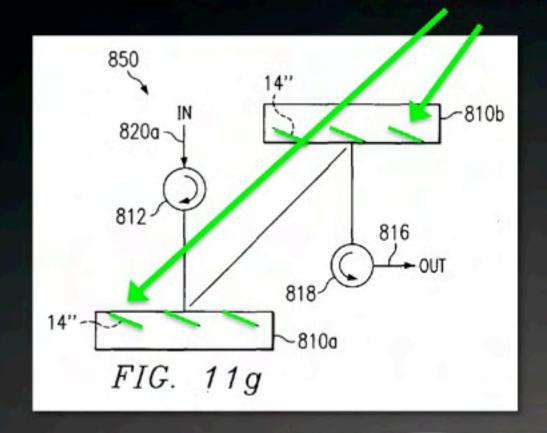
"an array of optical signal processing
devices [comprising] a plurality
of at least partially reflective mirrors"

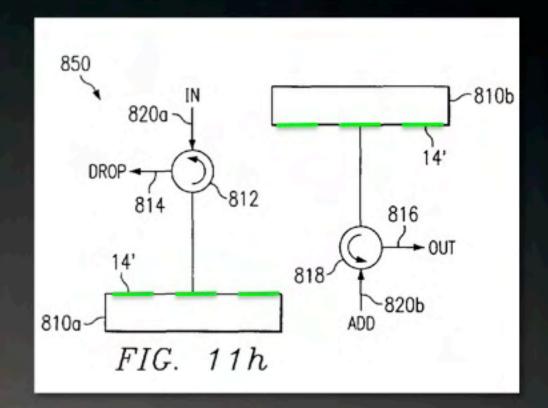
AND

"a moveable reflector"

Only One Embodiment Teaches the Use of Both Rotating Mirrors AND a Moving Reflecting Device

The devices are **both** variable blazed gratings





FIGS. 11g and 11h are block diagrams showing still another embodiment of an optical add/drop multiplexer 850 implementing blazed grating technology. In this example, add/drop multiplexer 850 includes two blazed grating elements 810a and 810b, each communicating with one of circulators 812 and 818. Circulator 812 receives input signal 820a and is coupled to a drop port 814, while circulator 818 receives added signal 820b and is coupled to output port 816.

A Variable Blazed Grating Can Act as a Single "Reflector"

Contrary to Cheetah's argument, the patent speaks of multiple mirror strips in a variable blazed grating "reflecting" a single input beam

In this embodiment, apparatus 100 operates in reflection mode when strips 14 reside at positions 14'. In that mode, input beam 20 impinges on strips 14 at angle PHI and is reflected as shown by output beam portion 24 at an angle of 180 degrees minus PHI. In diffraction mode, strips 14 reside at positions 14" at an angle THETA from position 14'. In this case, grazing angle PHI is selected to result in a diffraction angle that is approximately equal to the incident angle (ninety degrees minus PHI), resulting in input beam 20 being diffracted back in approximately the same direction as the origin of input beam 20, as shown by output rays 30 and 32.

Reflection

'714 Claim 18: The Reflection Limitation

- 18. A light processing system, comprising:
 - . . . a plurality of at least partially reflective mirrors
 - ... wherein at least some of the mirrors are operable to undergo a partial rotation in response to the control signal, the partial rotation resulting in a reflection of the at least some of the portion of the first signal part

'714 Claim 19: The Reflection Limitation

- 19. A method of processing one or more optical signals, the method comprising:
 - ... rotating at least some of the mirrors in response to one or more control signals, the rotation of the at least some of the mirrors resulting in a reflection of the at least some of the portion of the optical signal.

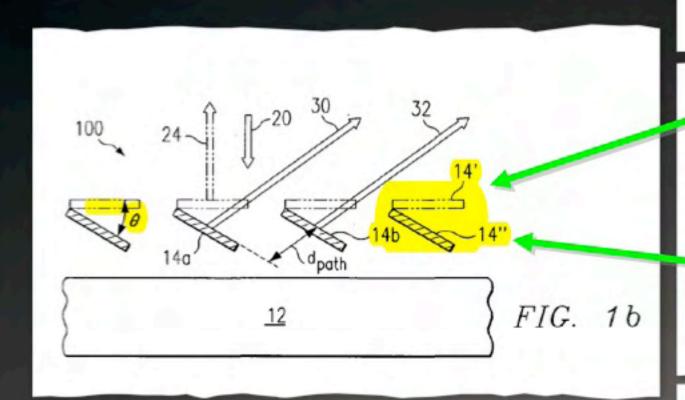
'714 Claims 18 and 19: The Reflection Limitation

Cheetah's Construction

Defendants' Construction

Rotating the mirrors to reflect at least some portion of the first signal part (claim 18) / optical signal (claim 19) These limitations require that the "array of optical signal processing devices" operate in the disclosed "reflection mode," i.e. redirecting light from a mirror that is parallel to the inner conductive layer.

The '714 Patent Distinguishes Between Reflection Mode and Diffraction Mode



"reflection mode,"

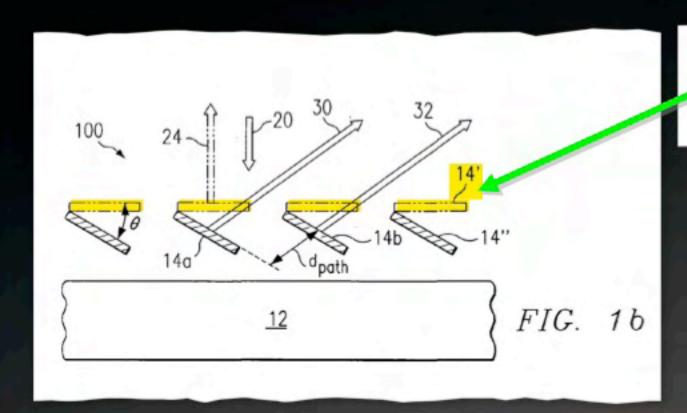
Strips 14 at position 14' (shown in dotted lines) show apparatus 100 operating in "reflection mode," where strips 14 operate to reflect input optical beam 20 as reflected signal 24. In this case, because input beam 20 is oriented normally to the surfaces of strips 14, reflected beam 24 is communicated back in the same direction from which input beam 20 originated. As will be discussed below, non-normal input angles could also be used.

Strips at positions 14" (shown in solid lines) depict strips
14 during a second mode of operation, "diffraction mode."
In diffraction mode, strips 14 are each rotated by approximately a blaze angle THETA from the original position of strips 14. In a particular embodiment, strips 14 can obtain a

"diffraction mode."

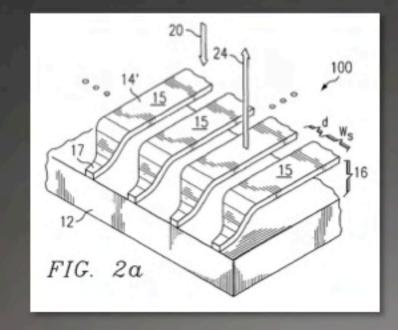
'714 Patent, col. 4 II. 11-24.

In "Reflection Mode," the Mirrors are Parallel to the Inner Conductive Layer

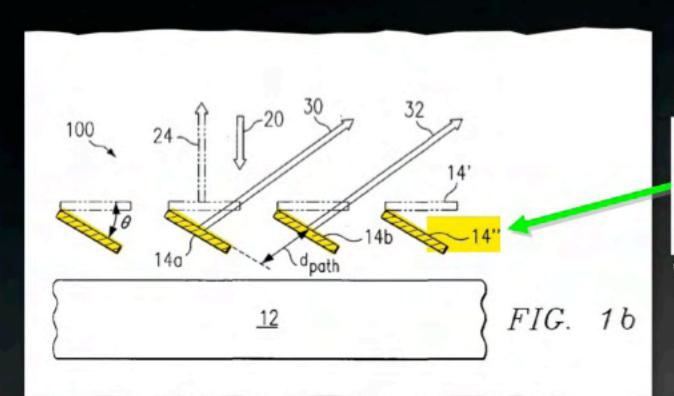


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'714 Patent, col. 4 II. 11-14.

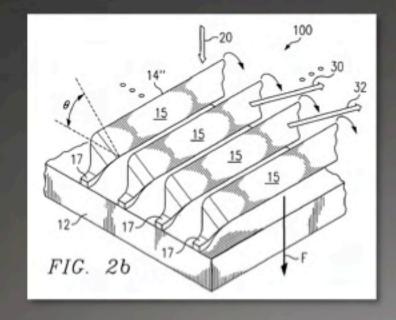


In "Diffraction Mode," the Mirrors are Angled to the Inner Conductive Layer



Strips at positions 14" (shown in solid lines) depict strips 14 during a second mode of operation, "diffraction mode." In diffraction mode, strips 14 are each rotated by approximately a blaze angle THETA from the original position of strips 14.

'714 Patent, col. 4 II. 20-24



In the '714 Patent, "Reflect" and "Diffract" Mean Different Things

In some aspects of operation, variable blazed gratings operate to reflect or diffract signals along the same signal path as that of an optical signal being input to the grating.

'714 Patent, col. 1 II. 39-42.

In some aspects of operation, variable blazed gratings operate to reflect or diffract signals along the signal path of the same or another input signal.

'714 Patent, col. 12 II. 56-58.

Where variable blazed grating 10 operates to reflect or diffract signals back in the direction of any input signal to the system, circulators could be used to redirect the reflected or diffracted signals to enhance system performance.

'714 Patent, col. 20 II. 1-5.

Where variable blazed grating 10 operates to reflect or diffract signals back in the direction of any input signal to the system, circulators could be used to redirect the reflected or diffracted signals to enhance system performance.

"Reflect" Refers to the Reflection Mode (Parallel Mirrors) and "Diffract" Refers to the Diffraction Mode (Angled Mirors)

In reflection mode (as indicated in FIG. 4a by dashed lines) apparatus 110 substantially reflects input optical beam 20 back in the same direction as output beam 24. In diffraction mode, apparatus 110 diffracts input optical beam 20 primarily in a direction as indicated by output rays 30 and 32.

'714 Patent, col. 8 II. 34-39.

In a reflection mode of operation, blazed grating apparatus 115 receives optical input beam 20, and reflects beam 20 at an angle equal to the angle of incidence of beam 20.

'714 Patent, col. 9 II. 47-49.

In diffraction mode, blazed grating 10 is displaced to position 14" at an angle THETA from position 14'. Blazed grating 10 receives optical input beam 20a and diffracts a majority of that beam toward circulator 708, which directs that portion of the beam to output 706.

Claims in the '714 Patent Family Distinguish Between Reflection and Diffraction Too

United States Patent

(10) Patent No .:

US 6,721,473 B1

Islam et al.

(45) Date of Patent:

Apr. 13, 2004

- 43. An optical switching element comprising:
- a plurality of approximately adjacent at least partially reflective mirror strips disposed outwardly from the inner conductive layer, each strip operable to receive a portion of an input optical signal wherein each of the plurality of strips is operable to undergo a partial rotation resulting in a reflection of a majority of the input signal toward an output; and
- 51. An optical switching element, comprising:
- a variable blazed grating operable to receive a first optical input signal from a first input and to reflect the first signal toward a first output while the grating remains in a first position, the variable blazed grating further operable to undergo a displacement to a second position, the displacement resulting in a diffraction of a majority of the first input signal toward a second output;

The '714 patent claims priority to U.S. Patent No. 6,721,473, its grandparent.

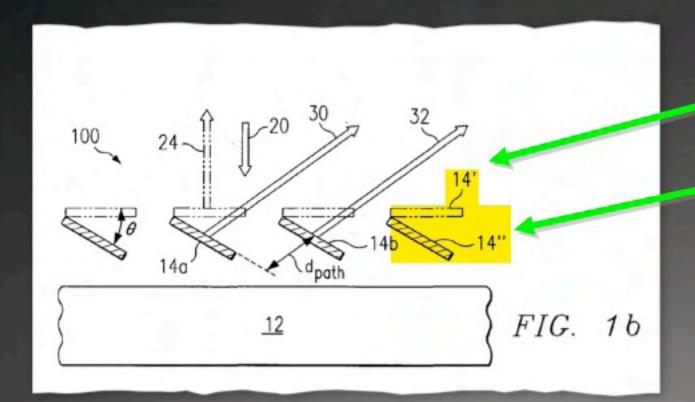
Cheetah Erroneously Argues that a Mirror Cannot "Rotate" to a Parallel Position

PLAINTIFF CHEETAH OMNI'S P.R. 4-5(c) REPLY BRIEF ON CLAIM CONSTRUCTION

(omitted in Defendants' Brief) readily resolves the debate. The claim expressly states that a

"rotation" of the mirrors results in the "reflection." Obviously, the mirrors are not "parallel" to

the inner conductive layer when they are "rotated."



But the mirrors can rotate

to a parallel position (14')

from the tilted position (14")